5200

WORK PLAN

PILOT TEST OF WESTERN SPRUCE BUDWORM CONTROL STRATEGY IN THE MIXED CONIFER FORESTS OF REGION 1 USING REGISTERED FORMULATION OF ZECTRN NEZPERCE NATIONAL FOREST, IDAHO

Prepared by: William M. Ciesla

Jerald E. Dewey

Mark D. McGregor

Entomologists, Forest Insect and Disease Branch
Region 1, Missoula, Montana

Reviewed by: /s/ Charles A. Wellner

/s/ Richard I. Washburn

Intermountain Forest and Range Experiment Station

/s/ Dr. Kenneth H. Wright

Pacific Northwest Forest and Range Experiment Station

Approved by: /s/ Dr. Donald C. Schmiege

Insecticide Evaluation Project
Pacific Southwest Forest and Range Experiment Station

Approved by: /s/ David E. Ketcham

Director, Division of Forest Pest Control
Washington, D.C.

INTRODUCTION

Western spruce budworm, Choristoneura occidentalis Freeman, periodically reach epidemic levels over large areas of the Northern Rocky Mountains. Severe infestations can persist for over 15 consecutive years if left unchecked. Budworm feeding can affect diameter and height growth of the host. Long-lasting infestations can cause top kill and tree mortality. At the present time nearly 4 million acres of forest lands are infested with budworm in the Region. Much of this acreage contains timber stands that are uneconomical to manage, and some areas show a declining trend in budworm populations. However, many high value, intensively managed stands are also being damaged by budworm outbreaks. In these areas, it is desirable to safely, effectively, and economically reduce budworm populations to a tolerable level.

Efforts at chemical control of western budworm began about 1948. DDT was sprayed aerially at the rate of 1 pound in 1 gallon of diesel oil per acre. Several million acres were treated during the 1950's. The overall effectiveness of DDT spraying is unresolved. Concerning several years of DDT spraying in Oregon and Washington, Carolin and Coulter (1971) said, "DDT spraying neither shortened nor extended the duration of the outbreak, but it saved much valuable timber for future use by reducing budworm population levels and resultant damage." 1/ Though high budworm mortality was achieved with DDT, several undesirable traits appeared. In 1964 it was ruled that the undesirable properties of DDT outweighed the good and it was no longer used for budworm control.

In the mid-sixties, malathion replaced DDT as the registered chemical to be used against budworm. Though malathion degrades rapidly, it gives quite erratic budworm mortality and is injurious to fish and many beneficial insects.

In early 1964, interest was expressed by research scientists, in Zectran insecticide (4-(dimethylomino) - 3, 5, -xylyl methylcarbamate) as a chemical for budworm control. Preliminary laboratory tests showed it to be highly toxic to budworm, have a short residual life, and quite safe to handle. Laboratory tests led to field tests, which ultimately resulted in registration of Zectran for budworm control. Zectran is registered to be applied at the rate of 0.15 pound in 1 gallon of oil carrier per acre.

1/ Carolin, V. M. and W. K. Coulter. Trends of western spruce budworm and associated insects in Pacific Northwest forests sprayed with DDT. Jour. Econ. Ent., vol. 64, no. 1, 1971.

This formulation was selected following a 1966 pilot test in the Bitterroot National Forest where budworm populations were reduced by 87 percent in a 3,585-acre unit and by 77 percent in another 1,190-acre unit. Tests in 1967, 1968, and 1969 were aimed at reducing the spray droplet size and the dosage rate. Budworm reductions were often less than satisfactory in 1967-1969.

An additional pilot test of Zectran is planned for 1971 on State and Nezperce National Forest lands near Grangeville, Idaho.

OBJECTIVES OF TEST

The objectives of the 1971 test are:

1. To test the strategy of applying registered Zectran FS 15 to protect resource values on relatively small areas until natural factors suppress surrounding budworm infestations. This will be done by remeasuring budworm population levels and defoliation within the spray blocks for at least three successive years.

2. To test the effectiveness of registered Zectran FS 15 in reducing budworm populations in mixed stands of true firs, Douglas-fir, spruce, and larch rather than on the pure Douglas-fir stands previously tested.

3. To evaluate the effect of registered Zectran FS 15 on budworm parasites.

DESCRIPTION OF TEST

The test will include spraying 3 areas of approximately 3,000 each (one treatment replicated twice). Treatment will be: 0.15 Z - TPM/gallon of deodorized kerosene/acre (Zectran FS 15, registration number 464-390). Insecticide will be applied aerially using a conventional spray system equipped with SB-80015T-Jet nozzles to provide spray droplets with 80-150 microns m.m.d. Three check units will be established to measure natural budworm mortality and check for catastrophic loss of the insect population. All units will be approximately 5 air miles apart to avoid drift contamination.

LOCATION OF TEST BLOCKS

Location of test blocks follows (figure 1):

1. Spray Blocks

   a. Cougar Creek
   b. North Meadow Creek
   c. Service Flats (Idaho Department of Public Lands)

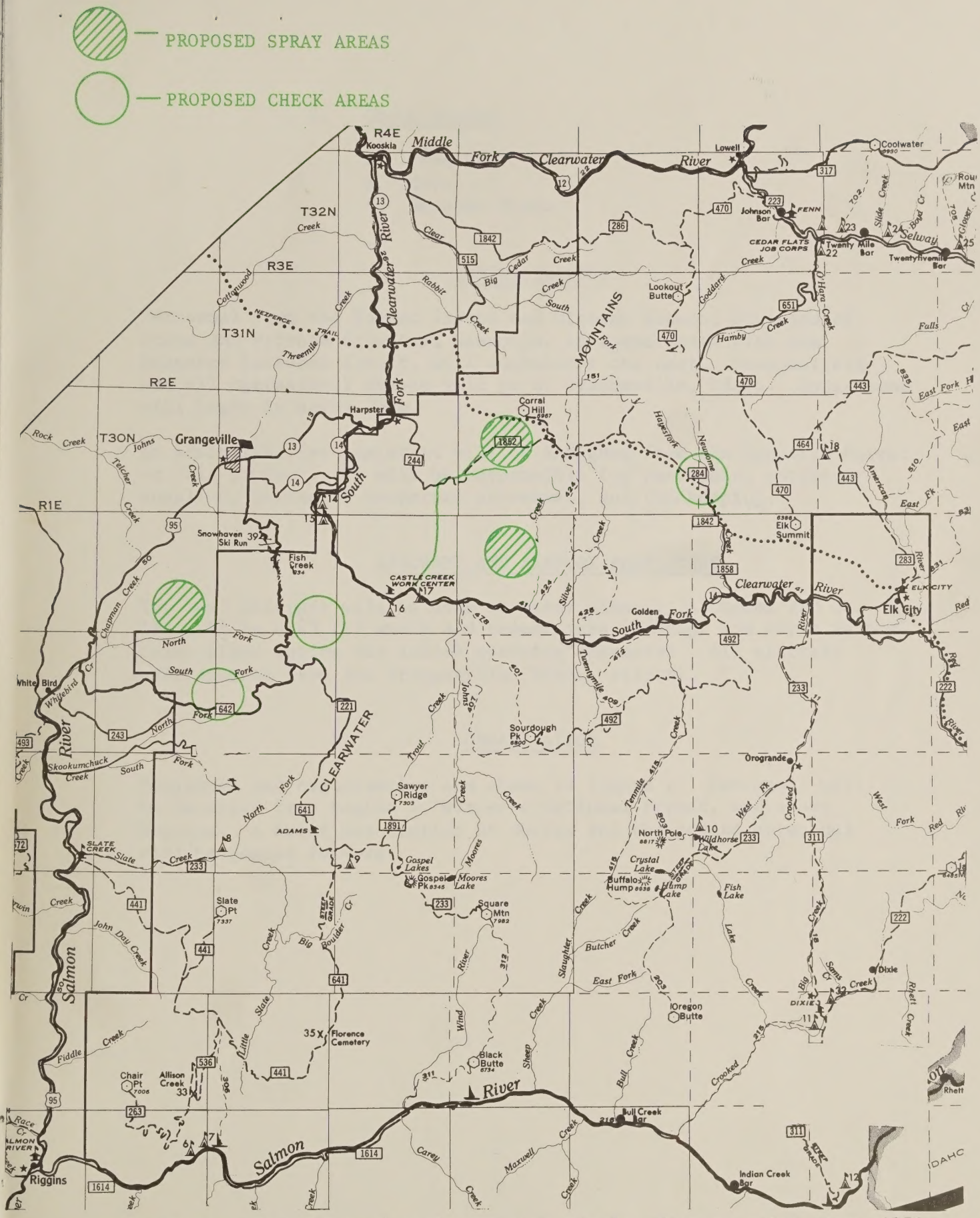


Figure 1.--Approximate location of test blocks, Zectran pilot test, 1971

2. Check Blocks

a. Free Use
b. Cove
c. Newsome Creek

ADMINISTRATION

Personnel from the Forest Insect and Disease Branch, Division of State and Private Forestry, Missoula, in cooperation with the Nezperce National Forest, will administer the test. Headquarters and all operational phases will be at Grangeville, Idaho. Operations will begin in early June.

An administrative assistant will be assigned from the Nezperce Forest to this project. He will be responsible for purchasing necessary supplies, hiring of temporary personnel, and timekeeping.

AIRCRAFT AND AIRPORT FACILITIES

Two C-47 aircraft will be used as spray planes. A Cessna 180 or 182 will be used for smoke and temperature readings and serve as the chase plane during the actual spraying operation. All aircraft will operate from the Grangeville, Idaho, airport.

ORGANIZATION

Personnel and organization are shown in figure 2. Personnel will be detailed from Region 1, Nezperce National Forest, and other Regions. A brief description of duties and the period personnel will be needed follows:

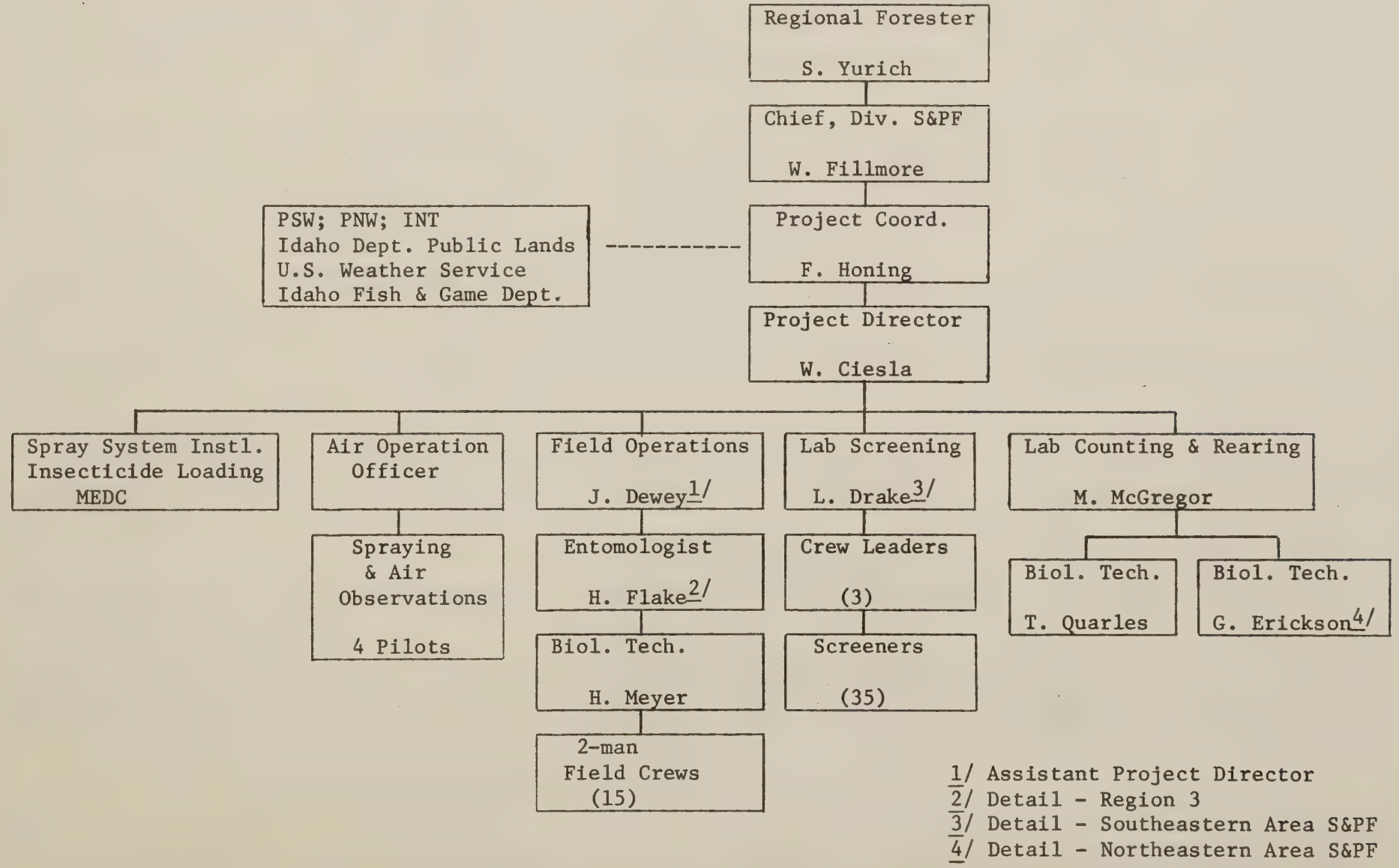
ZECTRAN PROJECT PERSONNEL AND DUTIES, F.Y. 1971 - F.Y. 1972

Project title	No. men	Type of men	Brief description of duties	To be provided by	Approximate period needed
Project director	1	GS-12 Entomologist	Overall supervision, planning management	RO - S&PF	January to final report.
Entomologist	4	GS-11 Entomologist	Train entomology crews, determine insect development for spraying, release spray blocks, determine insect mortality, rear and evaluate parasites.	RO - S&PF Detail	January to final report
Foliage checkers	35	GS-2 or 3	Count buds on foliage samples. Remove insects from foliage	Nezperce	June 10 to July 9
Field collectors	30	GS-3 to 5 Laborers	Take samples to evaluate insect readiness for spraying and mortality.	Nezperce	June 7 to July 6
Air operations officer	1	Pilot	Directs activities of aerial phases of testing program.	RO - FC	June 23 to July 11
Air operations			Acts as safety and liaison officer during developmental phases of spray equipment design. Act as air safety officer.	RO - FC	June 23 to July 11
Pilots	2	Pilots	Fly spray and observer and administrative aircraft as needed.	Contract	June 15 to July 5.

Zectran Project Personnel and Duties, F.Y. 1971 - F.Y. 1972, con.

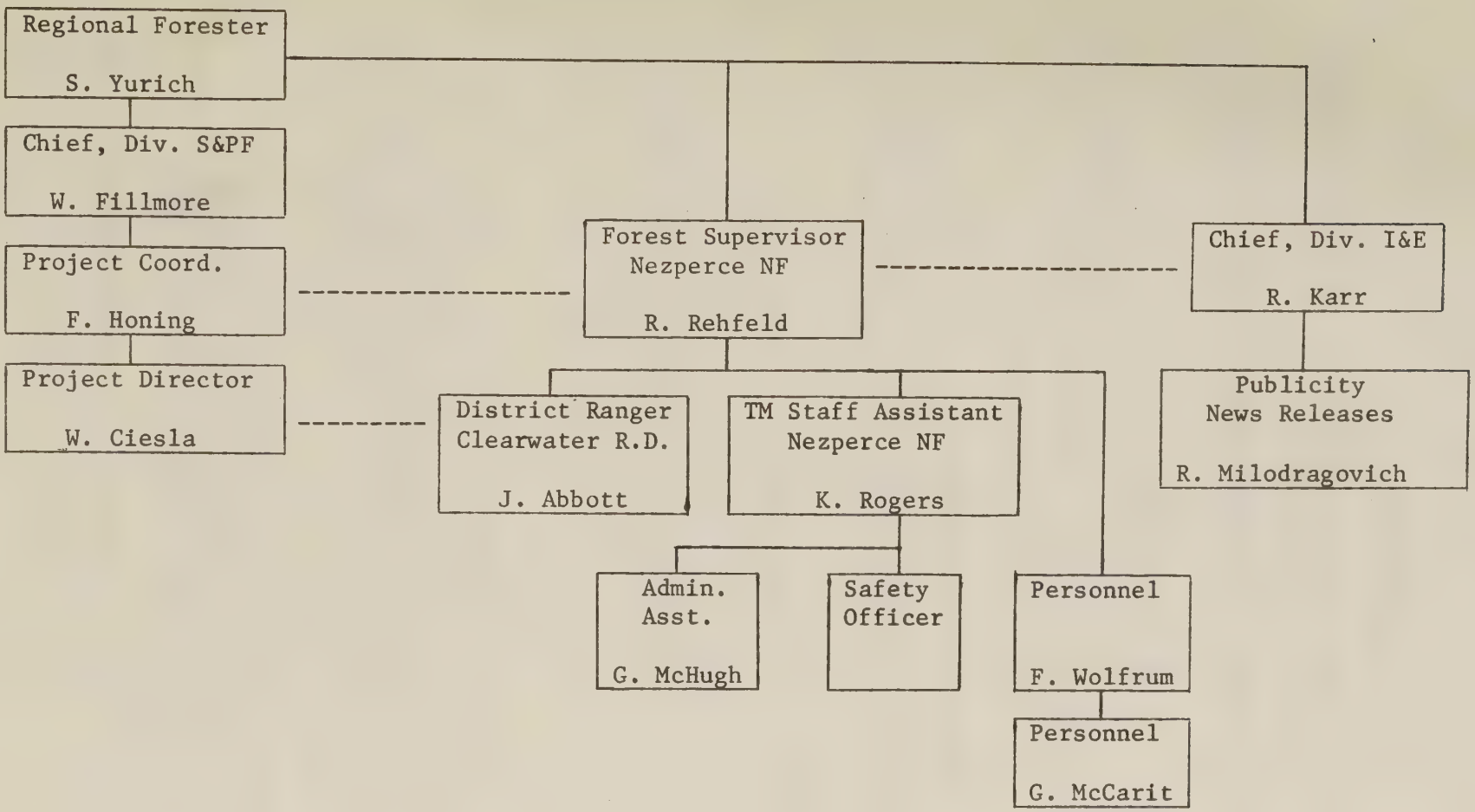
Project title	No. men	Type of men	Brief description of duties	To be provided by	Approximate period needed
MEDC	2	GS-11 Engineers	Design, install, and maintain spray equipment capable of producing spray drops from 80-150 microns in size. Load insecticide.	R1 - EDC	As needed
Administrative Asst.	1	GS-9	Order and issue supplies, act as timekeeper, prepare accident reports, etc.	Nezperce	June 10 to July 7
Safety Officer	1	GS-7 or 9	Conducts periodic safety training sessions and on-the-job inspections.	Nezperce	June 10 to July 7
I&E Officer	1	GS-7, 9 or 11	Administers I&E aspects of the project. (See Appendix II for I&E Action Plan.)	Nezperce	As needed

Figure 2.--Organization Chart for 1971 pilot test for western spruce budworm Nezperce National Forest, Idaho



1/ Assistant Project Director
2/ Detail - Region 3
3/ Detail - Southeastern Area S&PF
4/ Detail - Northeastern Area S&PF

Figure 2.--Organization Chart for 1971 pilot test for western spruce budworm Nezperce National Forest, Idaho con.



TRANSPORTATION

A total of 22 vehicles will be needed for the test. Vehicles will be furnished by the Regional Motor Pool, Nezperce Forest, or rented.

Each driver will be responsible for safety and maintenance of assigned vehicle.

COMMUNICATIONS

The Nezperce Forest air net radio system will be used to provide communications between aircraft, airport, and ground personnel. The regional air net will be used if needed.

METEOROLOGICAL INFORMATION

A meteorologist from the U.S. Weather Service will be assigned to the project prior to spraying. He will be responsible for monitoring and forecasting weather on proposed spray day.

Smoke will be released over the spray areas to indicate wind direction at different levels and identify air movement that may influence dispersion of spray particles. This information will be used to determine optimum spray release timing and duration of each day's work. Smoke may also be used to direct spray pilots over areas where spray runs are difficult to describe or accurately place on a map.

SAFETY

All Forest Service Employees

The safety program is the direct responsibility of the safety officer. Instructions outlined in the Forest Service Health and Safety Code Guide will be enforced. However, all supervisors will point out specific hazards and see that each employee follows safe working procedures. Each employee is responsible for:

1. Developing safe working habits and attitudes.
2. Assisting fellow employees in maintaining safe habits.
3. Checking vehicles each day to insure safe mechanical conditions.
4. Prompt reporting and documenting of all accidents to his immediate supervisor.
5. No smoking in insecticide loading and aircraft refueling areas.

Aircraft

Safety regulations developed for use of Forest Service aircraft will be followed.

As an added safety measure, pilots will be required to wear respirators capable of filtering out any toxic fumes during actual spraying.

Shoulder harnesses will be worn when flying within 1,000 feet of the ground.

Emergency Jettison of Insecticide

In case of emergency jettison of insecticide load, the project coordinator will immediately notify the State Fish and Game Department, State Health Department, Regional Safety Officer, Pacific Southwest Forest and Range Experiment Station - Insecticide Evaluation Project.

Loading Insecticide

Once Zectran concentrate has been mixed with the carrier, it can be handled with about the same degree of safety as DDT sprays. Because of its low hazard from dermal exposure, it can be handled with a far greater degree of safety than many of the organic phosphates and other agricultural chemicals. However, loaders are commonly exposed to far greater quantities of any insecticide than they realize.

Zectran presents a low degree of hazard from eye and skin contact, but a moderate to high degree of hazard from ingestion. Because of its toxicity by ingestion, care will be exercised to avoid breathing spray mists of Zectran formulations. Everyone handling either the concentrate or dilute material will:

1. Be required to wear rubber gloves and clothing that will protect the body from accidental spillage.
2. Wash with soap and water as soon as possible after coming in direct contact with insecticide.
3. Eating or smoking while handling insecticide is prohibited.
4. Wear respirator to filter out any toxic fumes.

Only authorized personnel will carry out the loading operation. Care will be taken in removing the filler hose nozzle from spray tanks to prevent spillage of chemical on aircraft and ground. Spillage will be immediately washed off the loading area.

Accidental Exposure

If accidental exposure occurs:

1. Flush contaminated eyes with plenty of water and get medical attention.
2. If swallowed, induce vomiting by giving an emetic such as 2 tablespoons of salt in a glass of warm water. CALL A PHYSICIAN.

Zectran is a cholinesterase inhibitor. Atropine is an antidote. At least two local physicians in Grangeville will be alerted to the pilot test, chemical to be used and its antidote, and be prepared to administer medical assistance. Physician's names and phone numbers will be posted conspicuously at the loading facilities.

ENTOMOLOGICAL PHASES

Development Sampling

Development sampling will start on June 1 approximately 2 weeks after budworm break dormancy. Ten sampling points will be established in each spray block.

Douglas-fir and grand fir will be sampled at each point. Four 15-inch branches will be clipped from midcrown of each tree per point with extendable pole pruners. Branches from each tree will be bagged, tagged, and taken to the laboratory. In the laboratory, a crew of women will examine development samples as they would prespray and post spray samples. An entomologist or trained technician assigned to the laboratory will make certain all larvae are found. The laboratory entomologists will be responsible for instar determinations. Head capsule measurements will be made for early instar determination. Carolin's instar characteristic chart can be used for late instar separations, with periodic head capsule measurements as a check. Instar development will be tallied on form 59-5230-3 and charted daily.

Development samples will be collected every other day until fifth instars occur, then areas will be sampled daily. Development samples will not be collected from trees designated for prespray and post spray sampling.

Spray date will be projected prior to the time 50 percent of the larvae have reached fifth instar.

Sampling for Effectiveness of Spray Application

A sampling plan has been developed for this pilot test which describes in detail the experimental design, distribution of sample points, timing of data collection, analysis of data, and statistical tests. This plan appears as Appendix I.

Sampling and Spraying Schedule

Anticipated timetable for prespray sampling, spraying, and post spray sampling is as follows:

Day 1 - Prespray sample area 1 and control.
Day 2 - Prespray sample area 2 and control. Spray area 1.
Day 3 - Prespray sample area 3 and control. Spray area 2.
Day 4 - Spray area 3.

Day 6 - Post spray sample area 1 and control.
Day 7 - Post spray sample area 2 and control.
Day 8 - Post spray sample area 3 and control.

Laboratory Methods and Procedures

A modern well-lighted and ventilated warehouse will be used for laboratory phases of the project. Branch samples will be stored in refrigeration until they are examined, but not longer than 48 hours to avoid larval mortality.

Thirty-five trained examiners will remove larvae, pupae, and parasites from foliage and webbing with a camel-hair brush and place them in Petri dishes. Defoliated and non-defoliated current year's buds will be counted. Larvae are placed in Petri plates as they are removed from branch samples. Sample collection tags (figure 3) will accompany larvae from that sample and be secured to the Petri dish with a rubber band.

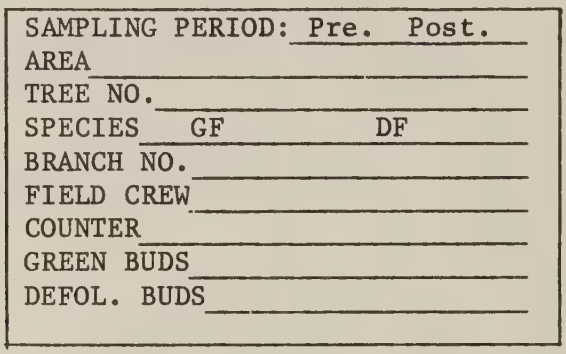


Figure 3 - Sample collection tag

An entomologist will separate different lepidopterous species prior to rearing. All larvae from samples will be counted, reared separately by sample tree. Data from sample collection tags and larval counts will be entered on form 59-5240-3 (figure 4). No more than ten larvae will be placed in each Petri dish with a 1- by 2-inch piece of artificial media[2/] for rearing. A 5- by 5-inch piece of parafilm "M" will be placed between the lid and bottom half of each Petri dish to prevent larvae from escaping. Petri dishes containing larvae from each tree will be labeled, sample collection tag attached and then secured together with rubber bands and shelved for rearing.

Adult moths and parasites will be recovered from rearings, to measure levels of parasitism in treated and untreated areas. Sex of moths will be determined to compare sex ratios in treated and untreated areas. Parasites and Dioryctria spp. will be submitted to specialists for identification.

Diseased larvae will be submitted to Dr. H. Thompson, Forestry Sciences Laboratory, Corvallis, Oregon, and Dr. Gerard M. Thomas, University of California, Berkeley, for identification.

2/ Lyon, L. R. and H. W. Flake, Jr. Rearing Douglas-fir tussock moth larvae on synthetic media. J. Econ. Ent. 59(3): 696-8, 1966.

WESTERN SPRUCE BUDWORM
PILOT TEST - TREE DATA SHEET

PRESPRAY SAMPLE

BLOCK_____ TREE_____ SPECIES_____ DATE_____ COLLECTOR_____

BUD COUNTER_____ INSECT COUNTER_____

	BUDS			BUDWORM			OTHER INSECTS	
BRANCH	GREEN	DAMAGED	TOTAL	LARVAE	PUPAE	TOTAL	DIOY.	OTHER LARVAE
1								
2								
3								
4								
TOTAL								

POSTSPRAY SAMPLE

BLOCK_____ TREE_____ SPECIES_____ DATE_____ COLLECTOR_____

BUD COUNTER_____ INSECT COUNTER_____

	BUDS			BUDWORM			OTHER INSECTS	
BRANCH	GREEN	DAMAGED	TOTAL	LARVAE	PUPAE	TOTAL	DIOY.	OTHER LARVAE
1								
2								
3								
4								
TOTAL								

Figure 4.

COSTS

Estimated costs for the 1971 pilot test are as follows:

Spray Application	
Contract aircraft, Zectran, kerosene, etc., 9,000 acres @ $2 per acre	$ 18,000.00
Smoke and chase plane	450.00
MEDC - spray system installation, loading of insecticide, etc.	3,950.00
SUBTOTAL	$ 22,400.00
Administration	
Nezperce NF - Administrative Officer, I&E Safety Officer, etc.	3,000.00
Meteorological Monitoring Services	
U.S. Weather Service	5,000.00
Evaluation	
Plot location, preliminary data collection	
Salaries (1 entomologist, 1 biological technician)	2,200.00
Per diem	800.00
Prespray and Post spray sampling	
Salaries (3 entomologists, 2 biological technicians)[1/]	10,000.00
Per diem	2,500.00
Local labor - 65 field and lab assistants, $3 per hour, 30 days	25,000.00
Equipment and supplies	
Pole pruners, collecting equipment, etc.	4,000.00
Vehicle rental	12,000.00
SUBTOTAL	$ 56,500.00
TOTAL	$ 86,900.00

1/ Does not include detailers

APPENDIX I

SAMPLING PLAN
1971 WESTERN SPRUCE BUDWORM PILOT CONTROL TEST
NEZPERCE NATIONAL FOREST, IDAHO

W. M. Ciesla and J. E. Dewey 1/

INTRODUCTION

A pilot test of Zectran for control of the western spruce budworm, Choristoneura occidentalis Freeman, is planned for 1971 on the Nezperce National Forest, Idaho. The objective of this test is to evaluate strategy of applying the Zectran formulation currently registered for spruce budworm control on small units of mixed conifer forest within a larger infestation. This formulation consists of 0.15 pound Zectran TPM in 1 gallon of deodorized kerosene per acre applied by fixed-wing aircraft. Spray droplet size will be in the medium range, 100-150 microns m.m.d. This work plan describes the test design and sampling procedure to evaluate this test.

TEST DESIGN

The test will consist of two treatments, spray and check, each replicated twice. Each study block will consist of 2,500 to 3,000 acres laid out to coincide with natural boundaries, primarily ridgetops. Forest cover type in each block will contain considerable areas of young, pole-size, mixed conifer stands consisting predominately of grand fir, Abies grandis, and Douglas-fir, Pseudotsuga menziesii. The test will be evaluated by comparing prespray and post spray population densities and survival ratios in treated and untreated blocks.

SAMPLE POPULATION

Species -- The sample population will consist of two host trees of the western spruce budworm, grand fir and Douglas-fir. It is understood that other species indigenous to the mixed conifer type of northern Idaho serve as host material for this insect, including subalpine fir, Engelmann spruce, and western larch. Western larch is not a common species on the Nezperce National Forest, and it would be extremely difficult to find sufficient trees to sample.

1/ This work plan was prepared as a result of consultation with Dr. Donald V. Sisson, Biological Statistician, Utah State University, Logan, Utah, and Dr. Albert Stage, Intermountain Forest and Range Experiment Station, Moscow, Idaho.

Subalpine fir and Engelmann spruce occur more frequently than larch, but their distribution is sporadic, tending to be concentrated along creek bottoms. This was found to be the case during the 1969 pilot control test on the Nezperce National Forest (Anon. 1969) where four species were included in the evaluation and only a small number of spruce and subalpine fir were found suitable for sampling.

Tree characteristics -- Sample trees are defined as Douglas-fir or grand fir, 30 to 50 feet tall, open grown, and not shielded by larger trees. Rationale for the selection of trees possessing these characteristics are adequately described in previous sampling plans (Insect Impact Project, 1969.)

Distribution of sample trees -- The forest cover type of the Nezperce National Forest consists of a wide variety of vegetational types, including clearcut units, ponderosa and lodgepole pine stands, mature and overmature stands of susceptible host type, as well as younger stands suitable for sampling budworm populations. Trees suitable for sampling budworm are not evenly distributed over the study blocks; consequently, a truly random or systematic means of selecting sample trees is impractical under these conditions. Therefore, sample trees will be selected in such a way as to provide a representative sample over each study block to the extent that vegetational types within each block permit.

Sample unit -- The basic sample unit will be a 15-inch branch taken at midcrown. Three crown levels were sampled during the 1969 pilot test and resultant data indicated that midcrown samples provided a representative sample of population densities.

Spruce budworm population densities have been expressed in a number of ways: number of larvae per 15-inch branch sample, number of larvae per 1,000 square inches of foliage, and number of larvae per 100 buds. Branch samples are extremely variable in terms of foliage area; consequently, it is difficult to make direct comparison of population densities per 15-inch sample. Surface area of foliage is calculated on the basis of the length and width of the branch sample. This is a grossly inaccurate measure of foliage area and branch samples are still not directly comparable. A measure of larvae per 100 buds is a somewhat better measure of population density because it relates the number of larvae to the number of potential feeding sites. Spruce budworm population densities will be expressed in terms of the number of larvae per 100 buds for the 1971 pilot test.

Collection of samples -- Two collections will be made from each sample tree. A prespray sample, collected 24 to 48 hours before the spray is applied, and a post spray sample taken 4 days after the spray is applied. This is based on the premise that Zectran is a short-lived material which persists for a maximum of 4 days. Any mortality beyond the 4-day period could, therefore be attributable to some cause other than the spray application.

SAMPLE SIZE

The sample size is based on data from the 1969 Zectran pilot test on the Nezperce National Forest. Population densities were expressed as number of larvae per 1,000 square inches of foliage, but bud counts were available and we were able to obtain counts of number of larvae per 100 buds from the existing data. Budworm counts from eight randomly selected grand fir and eight Douglas-fir were taken from the 1969 data for a prespray and 4-day post spray sample from each of two spray blocks and check blocks. The resultant data is as follows:

		Prespray			Post spray		
Species	Block	$\bar{x}$	S^2	C of V	$\bar{x}$	S^2	C of V
Grand fir	Fish Creek	16.86	33.23	0.342	6.44	133.06	1.792
	Skookumchuck	19.21	215.22	.764	5.88	52.46	1.232
	Free use check	16.33	117.68	.665	14.33	155.43	.870
	Fish Cr. check	18.85	49.82	.374	15.14	44.46	.440
Douglas-fir	Fish Creek	14.79	85.90	.627	6.84	53.14	1.065
	Skookumchuck	10.89	129.62	.045	9.51	96.25	1.032
	Free use check	12.01	106.73	.860	11.02	189.33	1.249
	Fish Cr. check	17.61	141.56	.675	12.78	55.42	.583

Prespray and post spray data for both grand fir and Douglas-fir were subjected to the following analysis of variance:

	df	SS	MS	EMS
Total	63	--	--	
Area	3	--	--	$S_b^2 + bS_t^2 + btS_a^2$
Trees within area	28	--	--	$S_b^2 + bS_t^2$
Branches within trees	32	--	--	S_b^2

Estimates of the population variance components for a given sample size were then obtained from the following relationships:

$$s_b^2 = MSb$$

$$s_t^2 = \frac{MSt - MSb}{b}$$

$$s_a^2 = \frac{MSa - MSt}{bt}$$

where s_b^2, s_t^2 and s_a^2 = branch, tree, and area variance components respectively,

MSb, MSt, MSa = mean square branches, trees, and areas respectively,

b = number of branches/tree,

t = trees/area,

and $s_{\bar{x}}^2 = \frac{s_b^2}{atb} + \frac{s_t^2}{at} + \frac{s_a^2}{a}$

where $s_{\bar{x}}^2$ is the variance of the overall mean.

These equations were solved for each treatment by species and prespray and 4-day post spray population densities, assuming a fixed value of 3 for a, the number of areas per treatment, and varying t, the number of trees per area and b, the number of branches per tree. Resultant data are summarized as follows:

PRESPRAY POPULATION DENSITIES

Species	b	t	s_x^2
Grand fir	2	75	2.5959
		50	2.7540
		25	3.2280
	4	75	2.5175
		50	2.6364
		25	2.9929
Douglas-fir	2	75	0.9780
		50	1.1502
		25	1.6773
	4	75	0.9065
		50	1.0432
		25	1.4529

POST SPRAY POPULATION DENSITIES

Species	b	t	s_x^2
Grand fir	2	75	5.4402
		50	5.6038
		25	6.0944
	4	75	5.3830
		50	5.5179
		25	5.9227
Douglas-fir	2	75	1.6005
		50	1.7926
		25	2.3686
	4	75	1.5638
		50	1.7370
		25	2.2586

These data show that for a given number of branch samples per tree (b = 2 or 4) there is relatively little difference between a sample size of 75 trees versus 50 trees. In addition, for a given value of t (25, 50, or 75) the selection of four versus two branch samples per tree has little effect in the variance estimates. It is possible, however, that a small branch sample size (b = 2) may result in higher post spray counts than prespray counts. Since the expense of taking four branch samples versus two branch samples is virtually negligible, it seems logical to take four branch samples from each tree. Therefore, sample size for the 1971 pilot project will consist of:

3 replicates per treatment
50 sample trees of each species per replicate
4 branch samples taken at midcrown from each tree 48 hours prior to spraying and 4 days after spraying.

ANALYSIS OF DATA

The following computations will be made from the data collected for each block by tree species:

1. Prespray budworm population density per 100 buds, n_i
2. Post spray budworm population density per 100 buds, A_i
3. Survival ratio - Pi

$$Pi = \frac{A_i}{n_i}$$

4. Corrected percent mortality for each treatment by species will be computed as follows:

100 (1.0 - survival treated/survival control)

5. Ninety-five percent confidence limits for survival ratios

$$Pi \pm 1.96 \sqrt{\frac{PQ}{N}}$$

where P = survival ratio

Q = 1 - P

N = number of observations

Differences between treatments and checks will be tested using a binomial Chi square test with 11 df in the following contingency table:

	A_1		A_2		A_3		C_1		C_2		C_3		Σ
	GF	DF	GF	DF	GF	DF	GF	DF	GF	DF	GF	DF	
A_i													ΣA_1
n_i													Σn_1
P_i	P_1	P_2	P_3									P_{12}	

Where A_i = post spray population density

n_i = prespray population density

$$P_i = \frac{A_i}{n_i}$$

Test the hypothesis:

$$H_0: P_1 = P_2 = P_3 = \ldots\ldots = P_{12}$$

as follows:

$$Chi^2 = \frac{\Sigma aiPi - \bar{P}\ \Sigma ai}{\bar{p}\bar{q}} \qquad \text{and } \bar{p} = \frac{\Sigma ai}{\Sigma ni}$$

where $\bar{q} = 1.0 - \bar{p}$

To test differences between treatment and check and species, summarize data in tables as follows:

	Spray	Check
A_i		
n_i		
P_i		

	GF	DF
A_i		
n_i		
P_i		

Compute Chi^2 with 1 DF

An approximate test for the spray by species interaction can be made by subtracting Chi^2 spray and Chi^2 species from the original Chi^2.

REFERENCES CITED

Anonymous. 1969. Resume of data analysis, 1969 Zectran pilot test. Typewritten report on file USFS R-1, Div. State & Private Forestry, Missoula, MT.

Insect Impact Project. 1969. Spruce budworm sampling plan for Idaho Zectran pilot test. USFS, NEFES, Hamden, CT.

APPENDIX II
SITUATION STATEMENT

PILOT CONTROL TEST FOR THE WESTERN SPRUCE BUDWORM

NEZPERCE NATIONAL FOREST, IDAHO

1971

INTRODUCTION

The western spruce budworm, Choristoneura occidentalis Free., one of the most destructive forest insects in North America, is presently epidemic over 4½ million acres of the Northern Rocky Mountains. The larvae feed on the foliage of a variety of conifers causing growth loss, top kill, and tree mortality. During the period 1946-1964, western spruce budworm populations were suppressed over large areas by aerial applications of DDT.

With DDT no longer available for budworm control, a research project in insecticide evaluation was established at the Pacific Southwest Forest and Range Experiment Station in Berkeley, California. This project was charged with the task of finding a substitute chemical, one that would be highly toxic to the budworm, reasonably selective, not persist in the ecosystem, and not having harmful effects on aquatic fauna, birds, game animals, or man. Scientists engaged in this research discovered that Zectran, a carbamate insecticide, closely met these specifications. Extensive laboratory tests, field experiments, and pilot tests, designed to measure Zectran's toxicity to the budworm, optimum formulation, application methods, and effects on other resource values, were conducted from 1964 to 1969. These tests provided sufficient data to register this material with the Pesticides Regulation Division of the U.S. Department of Agriculture, for western spruce budworm control.

1971 PILOT TEST

A pilot control test of Zectran is planned for 1971. The objective is to evaluate the strategy of applying the registered formulation of Zectran to suppress western spruce budworm infestations in small blocks of mixed conifer forests typical of northern and central Idaho, and to provide additional information on the application of this material over large areas. The registered formulation (0.15 pound Zectran TPM in 1 gallon of deodorized kerosene per acre) will be applied from a C-47 aircraft equipped with a conventional spray system. Spray will be applied to three areas, each approximately 2,500 acres in size. Spray droplet size will be in the medium range, 100-150 microns m.m.d.

The proposed test site is in the Nezperce National Forest and on adjoining State lands where the budworm has been epidemic for about 5 years. This test will be designed to measure the impact of Zectran on budworm populations in terms of percent population reduction and residual population density by comparing populations in spray blocks to untreated checks before and after spraying. Personnel from the Nezperce National Forest and the Division of State and Private Forestry, Forest Insect and Disease Branch, will be responsible for planning, coordinating, conducting, and evaluating this test.

RELATED STUDIES

This pilot test will provide an opportunity to conduct a number of related studies. Plans are being formulated to study population densities of budworm parasites in treated and untreated areas to obtain additional data on parasite activity in areas treated with Zectran. Spray deposit assessment, using fluorescent tracers, will be conducted by the Pacific Northwest Forest and Range Experiment Station. Meteorological conditions such as air currents, inversions, etc., which might adversely influence the success of aerial spray applications will be monitored by the National Weather Service. The Idaho Fish and Game Department has been invited to participate in the test and monitor the effects of Zectran on fish and wildlife populations with the test sites.

INSECT CONTROL DIRECTION

Insect control in the Northern Region is becoming more difficult daily. This is not because the "bugs" are harder to kill nowadays, but because of control restrictions we are putting on ourselves and having put on us. In the pre-1964 years, about the only prerequisite for a control program was to have some bugs. Now, in addition to an insect infestation, you need:

1. A sound economic analysis, including a cost-benefit evaluation.
2. An environmental impact evaluation.
3. A biological evaluation that indicates the condition will persist or worsen.
4. A number of other things, including an I&E action plan and an analysis of the attitude of the local citizenry toward the project.

Any chemical control work must be with USDA registered insecticides, using proven recommended procedures. The emphasis is for a quality project that will reduce the problem with as little effect upon other organisms and the environment as possible. This means avoiding "hard pesticides" (DDT and other chlorinated hydrocarbons) in favor of shortlived, more selective materials.

More emphasis is currently being placed on biological control than at any other time. Parasites are being released as control agents. In Region 5 a project is planned for this summer, spraying an insect virus to control a Douglas-fir tussock moth outbreak. Research is being conducted using sex-attractants, juvenile hormones, and other sophisticated control techniques.

In brief, our insect control management direction is to use chemicals only when no other suitable control measure exists and the need for control has been clearly established. And when using chemicals, use the ones that are most selective and have the least adverse effect on the environment.

Zectran Spray Project - F.Y. 1971

Information and Education Action Plan

Objective

To maintain effective communication with other Federal and State agencies, forest users, organizations, and general public to provide them a better understanding regarding forest management practices and gain their views regarding these practices.

Program	Responsibility	Date
1. News Release	RO - SO	5/10/71
Idaho County Free Press	RO - SO	5/10/71
Lewiston Morning Tribune	RO - SO	5/10/71
Cottonwood Chronicle	RO - SO	5/10/71
Spokesman Review	RO - SO	5/10/71
Orofino Tribune	RO - SO	5/10/71
Clearwater Progress (Kamiah)	RO - SO	5/10/71
Spokane Chronicle	RO - SO	5/10/71
2. Public Meetings		
Grangeville	RO	5/15/71
Lewiston	RO	5/15/71
3. Permittee Contacts (Mail or Personal Contact)		
Francis & Wayne James	R. Dist.	5/1-10/71
Jerry Brown	R. Dist.	5/1-10/71
Ludwig Conrad	R. Dist.	5/1-10/71
Art Case	R. Dist.	5/1-10/71
Bruce Scott	R. Dist.	5/1-10/71
John Groom	R. Dist.	5/1-10/71
Gertrude Hunter	R. Dist.	5/1-10/71
Al Schwartz	R. Dist.	5/1-10/71
Dewey Johnson	R. Dist.	5/1-10/71
Athol Von Bargon	R. Dist.	5/1-10/71
C. V. Packer	R. Dist.	5/1-10/71
Bert Heron	R. Dist.	5/1-10/71
Gene Auer	R. Dist.	5/1-10/71
Lytle Brothers	R. Dist.	5/1-10/71
Ted Tholl	R. Dist.	5/1-10/71
Delores Heimgarten	R. Dist.	5/1-10/71

4. Other Contacts (Mail or Personal Contact)

Pesticide-Use Coordinating Committee	RO	5/1-10/71
Soil Conservation Service	RO - SO	5/1-10/71
Grangeville Chamber of Commerce	RO - SO	5/1-10/71
County Agent	RO - SO	5/1-10/71
County Commissioners	RO - SO	5/1-10/71
James Calvert-Idaho Environmental Council, Moscow	RO - SO	5/1-10/71
Dean Ernest Wohletz-University of Idaho Forestry School, Moscow	RO - SO	5/1-10/71
Dean Grant Harris-School of Forestry, WSU, Pullman	RO - SO	5/1-10/71
Ernest W. Harting, President-University of Idaho	RO - SO	5/1-10/71
Arthur Manley-Legislator-Idaho Wildlife	RO - SO	5/1-10/71
Cecil Andrus-Governor-Idaho	RO - SO	5/1-10/71
John R. Woodworth-State Fish and Game Department	RO - SO	5/1-10/71
Gordon Trombley-Land Commissioner	RO - SO	5/1-10/71
Fenton Roskelley-Spokesman Review-Spokane	RO - SO	5/1-10/71
John Reed - Spokane Chronicle	RO - SO	5/1-10/71
Regional Forester's Inland Empire Forest Advisory Council		Before 5/1/71